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(71) Applicant
Honda Giken Kogyo Kabushiki Kaisha (Japan),
1–1 Minami-Aoyama 2-chome, Minato-ku, Tokyo 107,
Japan

(72) Inventors
Koichi Fukuo
Shinji Sasaki

(74) Agent and/or Address for Service
Frank B Dehn & Co,
Imperial House, 15–19 Kingsway, London WC2B 6UZ

(54) V i.c. engine crankcase breather system

(57) Interconnected chambers 16, defined by the wall 16*d* at the bottom of the cylinder block V and closure plates 16*c*, communicate with the crankcase 7 through ports (11, Figs. 4 and 5) outwardly of the walls (13) of the crankshaft bearings at opposite ends of the engine and with the valve gear chambers 3*a* through passages 17. The chambers 3*a* are connected one to the air intake filter 19*b* and the other to the intake manifold 19*a* through a PCV valve 18. Passages 22 provide return oil passage from the chambers 3*a* to the crankcase 7.

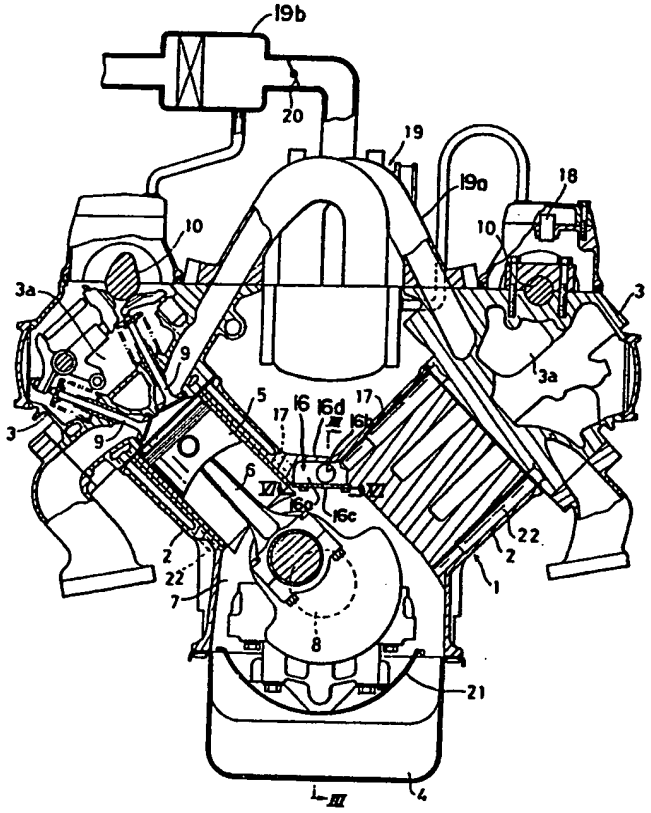

FIG. 2.

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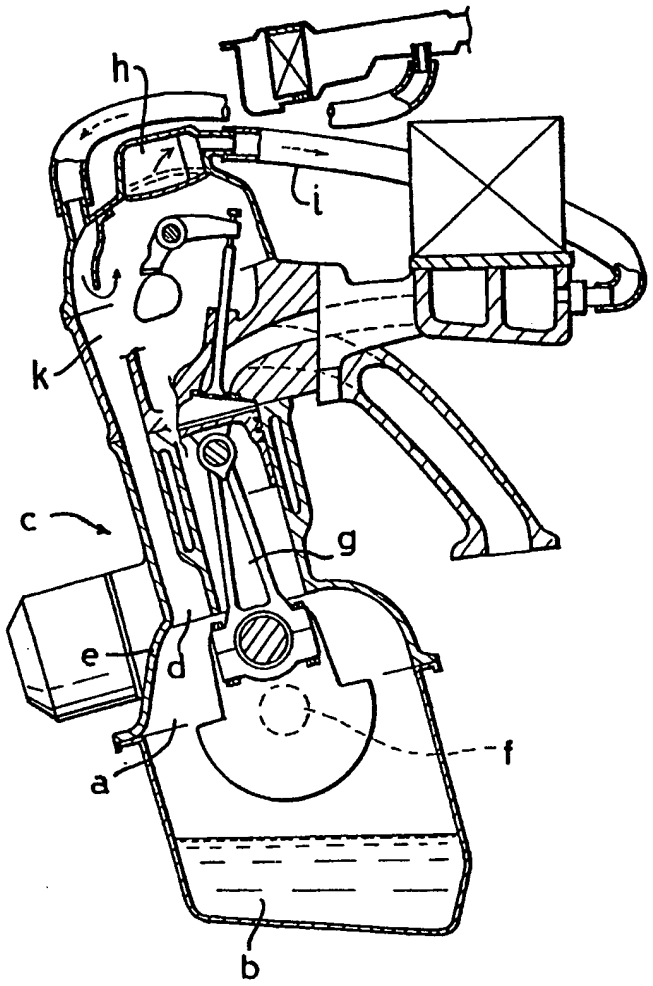

FIG. 1A.
PRIOR ART

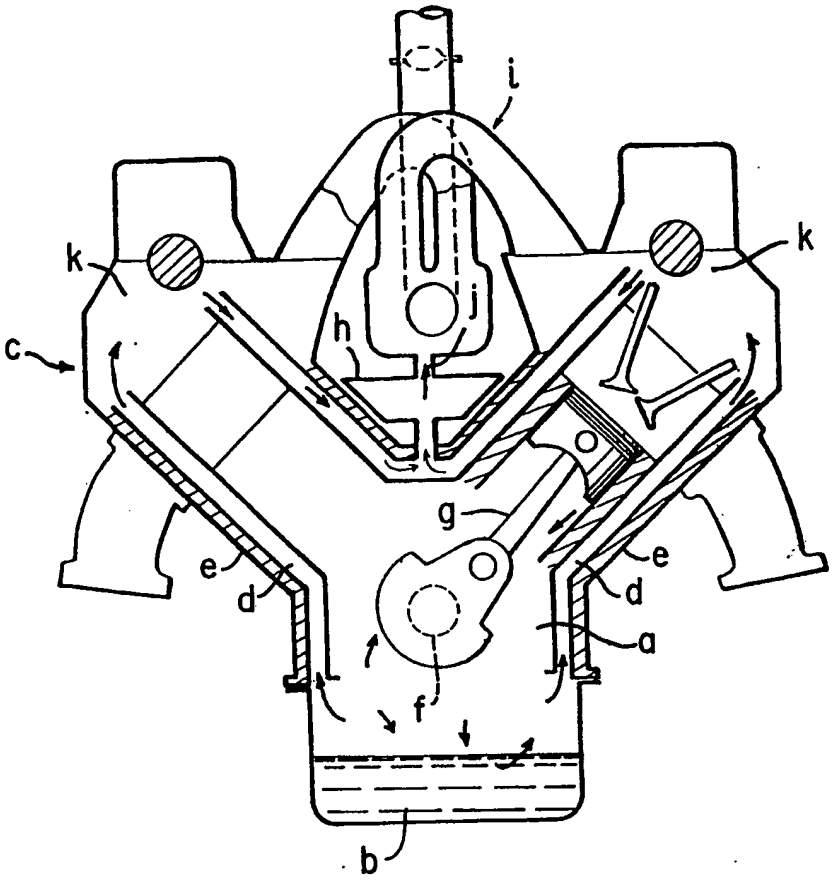

FIG. 1B.
PRIOR ART

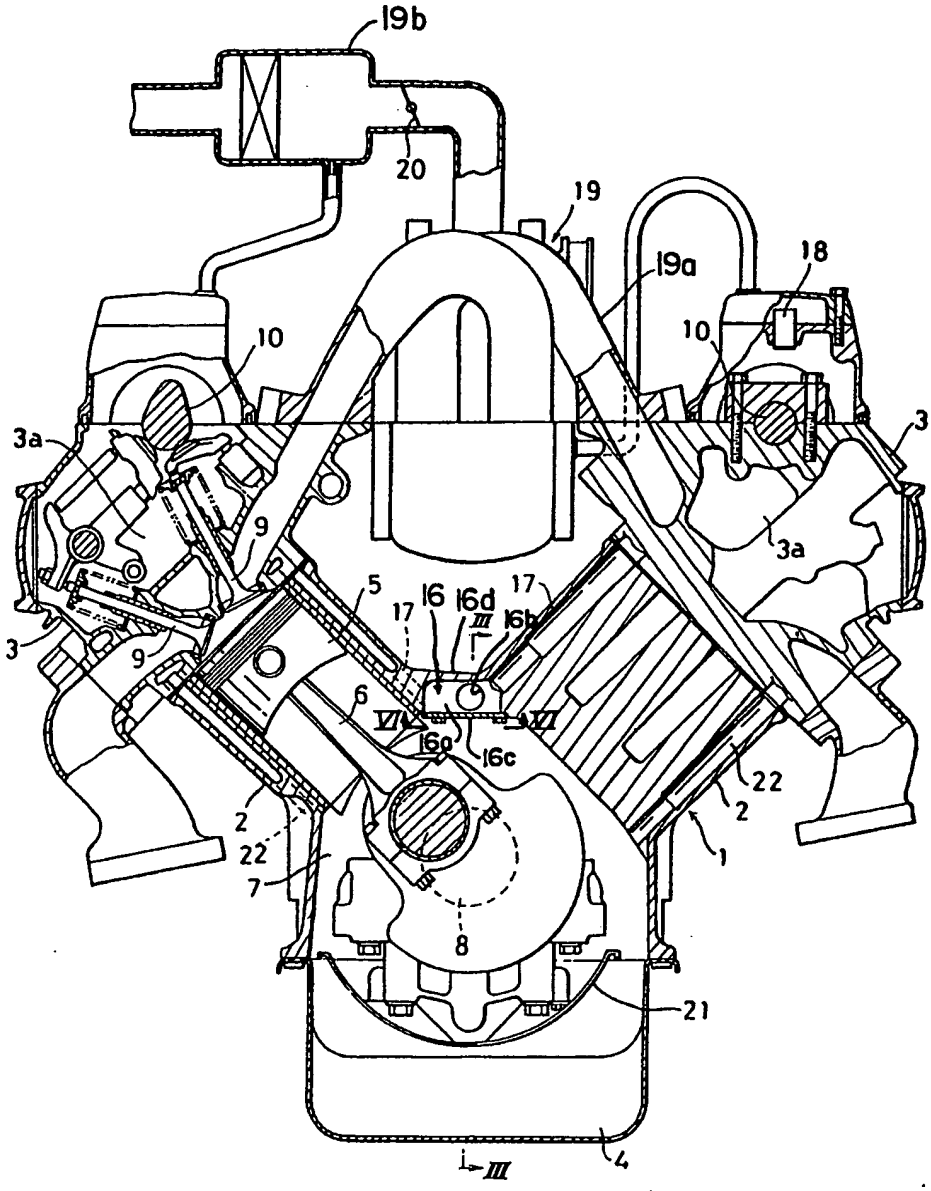
19b
20
19
19a
18
10
10
3a
3
3a
9
9
3
5
17
16
16d
III
16b
17
6
VI
VI
16a
16c
22
2
2
22
1
7
8
21
4
III

FIG. 2.

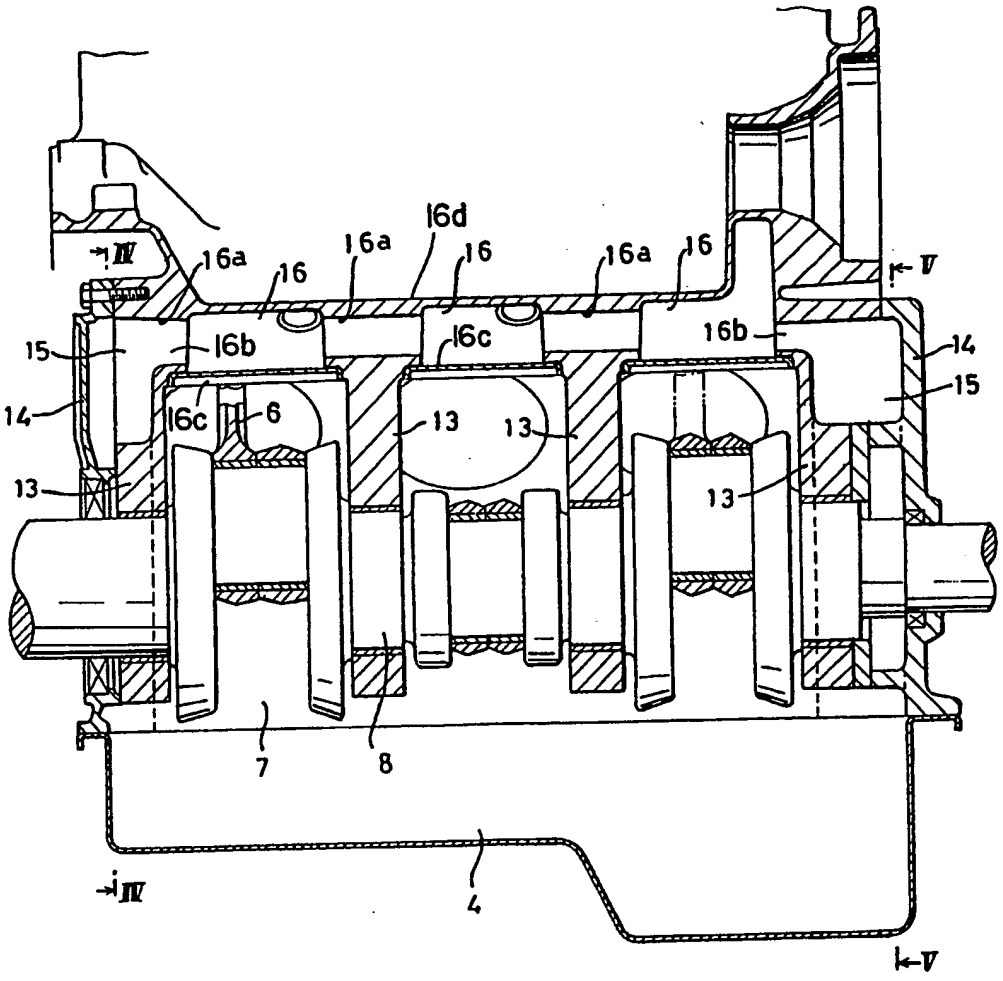
IV
16a
16
16a
16d
16
16a
16
V
15
16b
16c
16b
14
14
15
16c
6
13
13
13
13
7
8
IV
4
V

FIG. 3.

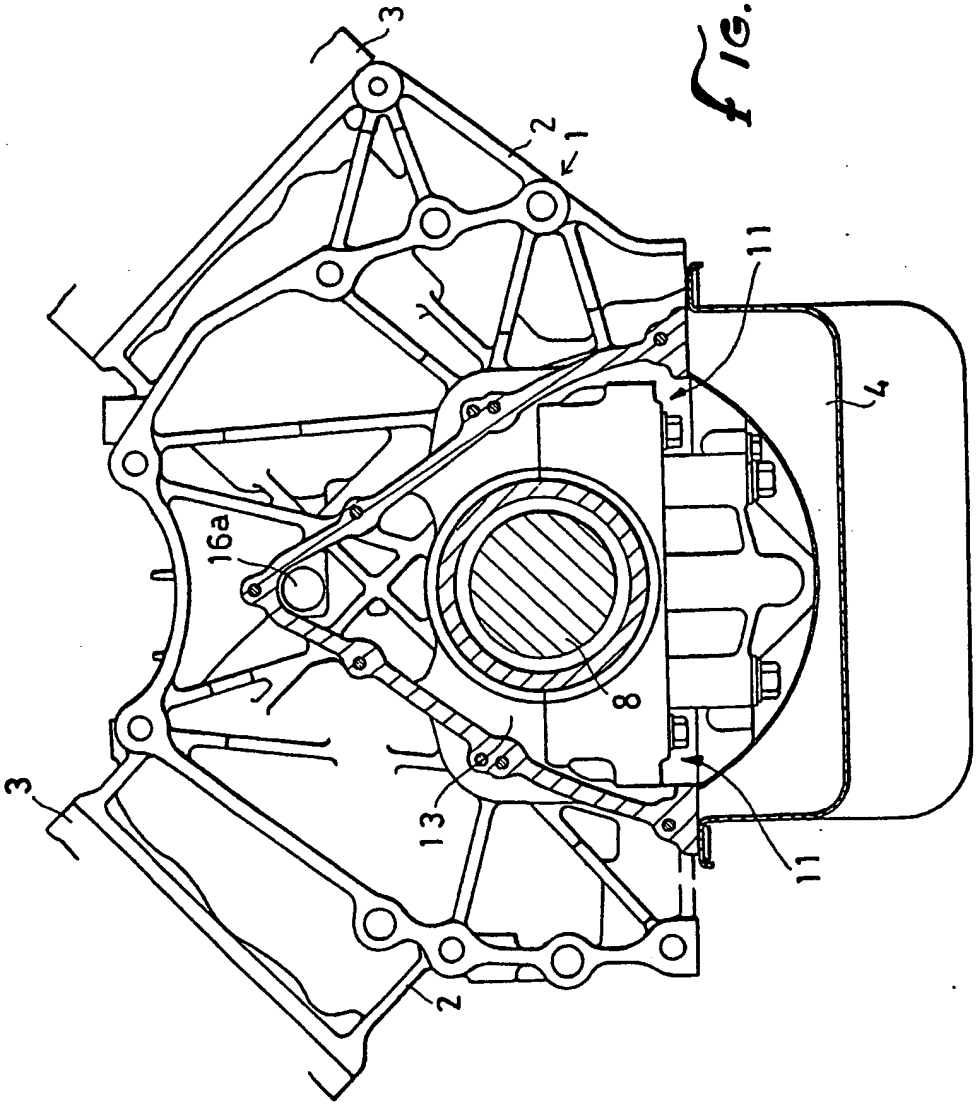

FIG. 4.

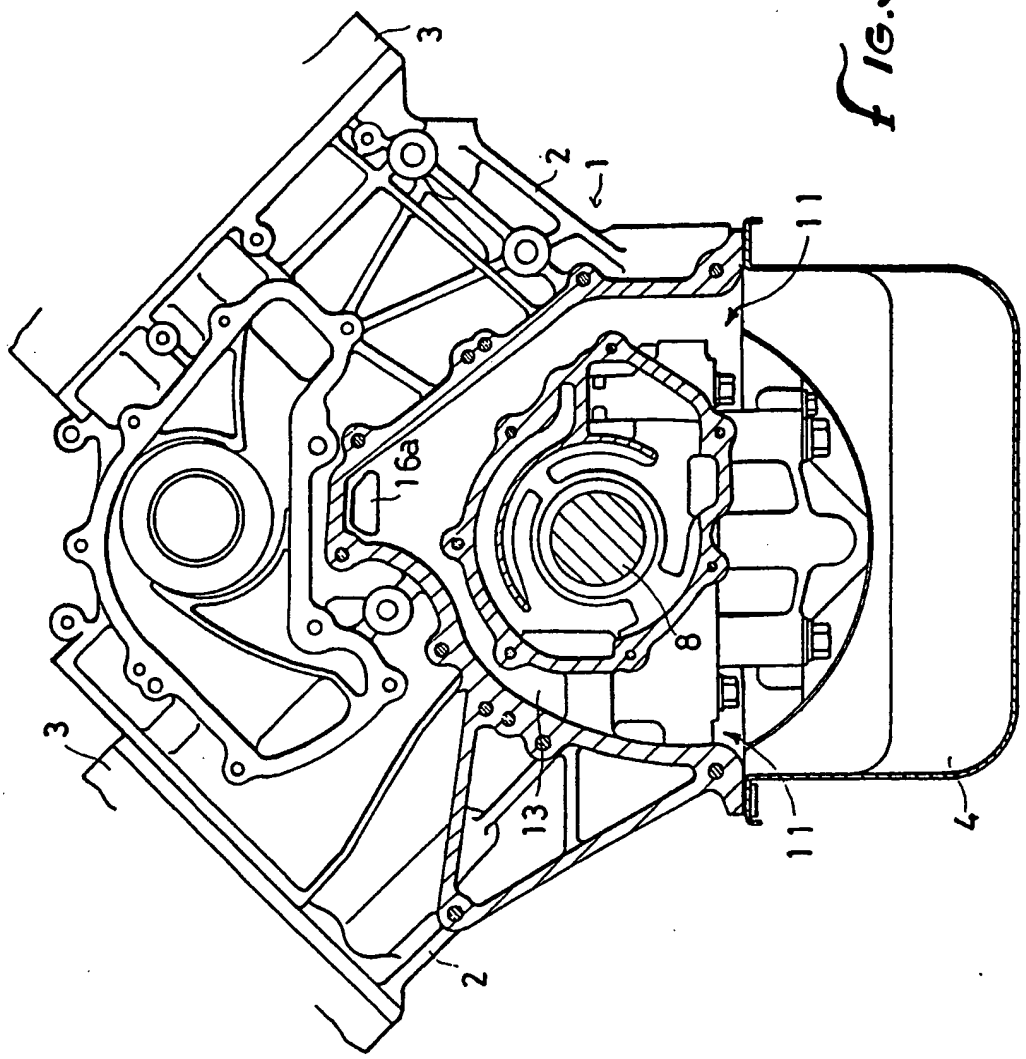

FIG. 5.

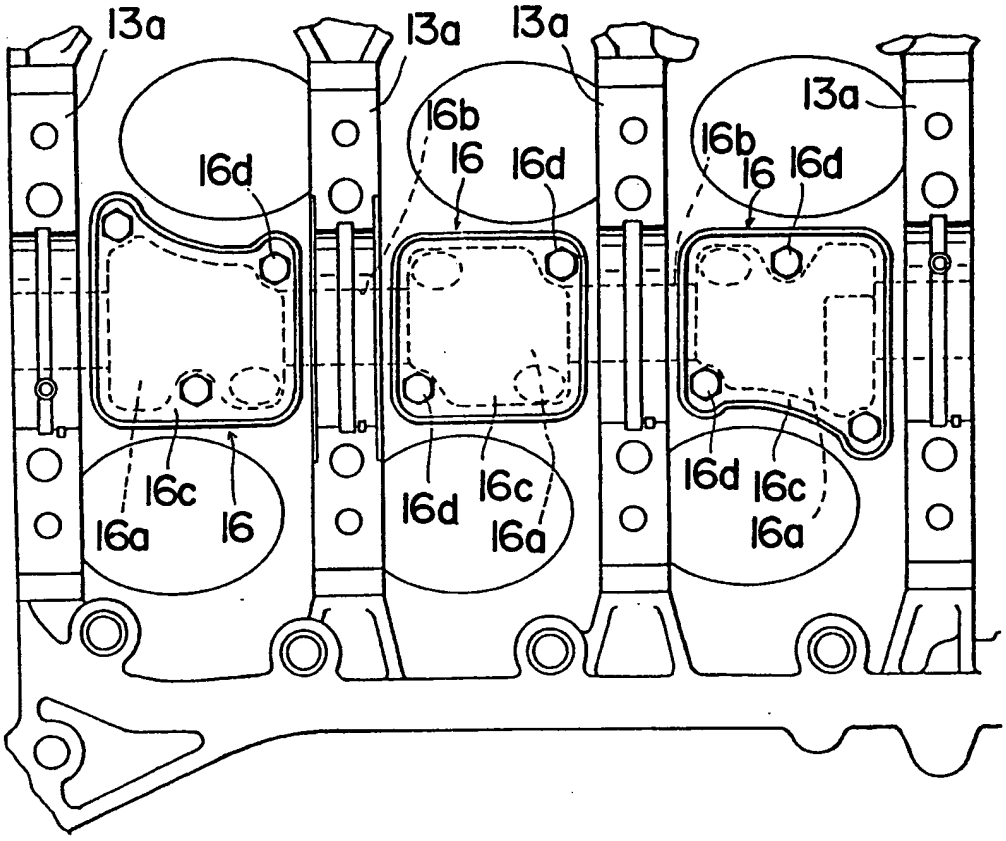
13a
13a
13a
13a
16b
16
16d
16d
16b
16
16d
16d
16c
16a
16
16d
16c
16a
16d
16c
16a

FIG. 6.

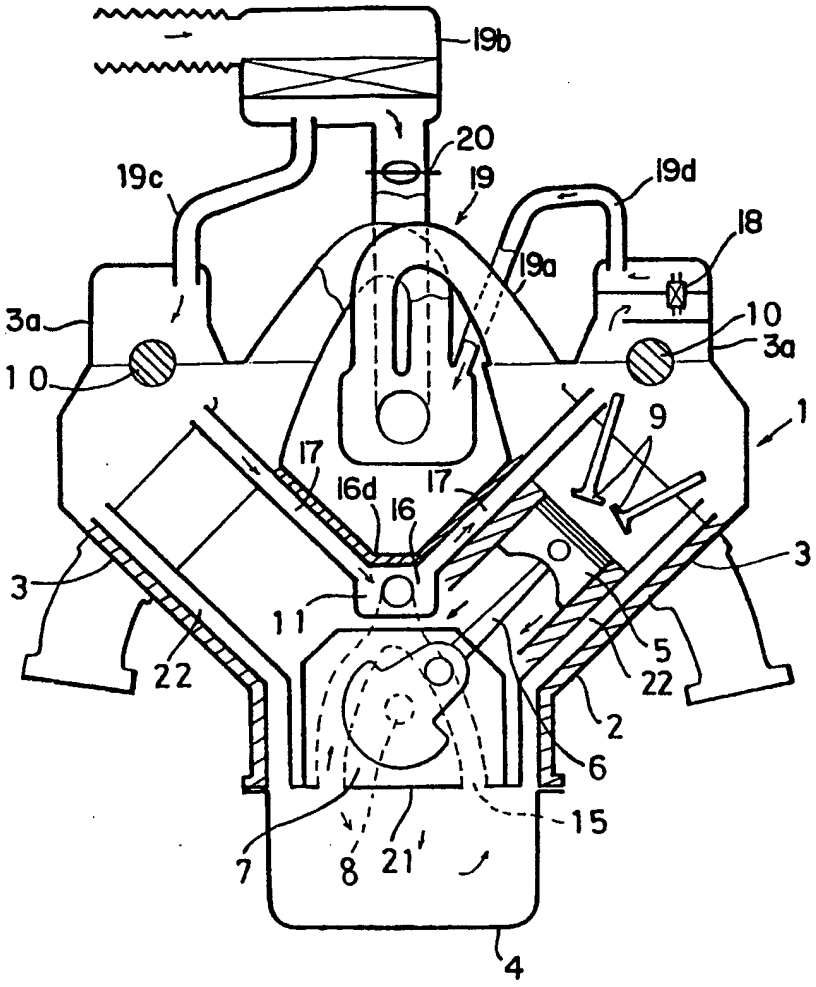
19b
20
19c
19
19d
18
19a
3a
10
10
3a
1
9
17
16d
16
17
3
3
11
5
22
22
2
6
15
7
8
21
4

FIG. 7.

SPECIFICATION

Breather system in internal combustion engine

The present invention relates to a breather arrangement in an internal combustion engine and, in particular, to an arrangement in the cylinder block for conducting the blow-by gases to the engine intake system with a reduced amount of entrained oil.

Heretofore, various arrangements and devices have been known and used for conducting the engine blow-by gases to the intake while reducing the oil entrained in those gases. One such arrangement is shown in the accompanying Fig. 1A in which a blow-by gas take-out port "d" is provided in a crankcase "a" of an engine "c" which has an oil sump "b" below the crankcase "a", and wherein the blow-by gas from the crankcase "a" is recycled to an intake system "i" through the take-out port "d", valve chamber "k" and breather cap or chamber "h". In this case, the take-out port "d" is generally provided in a skirt portion "e" of a cylinder above the crankcase "a".

In such an arrangement, the blow-by gas take-out port "d" is easily influenced by pressure variations caused by rotation of a crankshaft "f" because it is provided in the skirt portion "e' and leads directly to the valve chamber "k". Further, the oil splashes from the connecting rod "g" connected to the crankshaft "f" and is apt to be connected from the take-out port "d" through the blow-by gas passage leading to the valve chamber "k".

Another device and arrangement known and used in the prior art is disclosed in Japanese Utility Model Laid-Open Publication No. 100910/84 in which, as shown in the accompanying Fig. 1B, a V-type engine "a" is provided with a breather chamber "h", and the blow-by gas from a crankcase "a" is recycled through the chamber "h" to an intake system "i". Generally in this case, the chamber "h" is positioned above a V-bank bottom wall of the engine "c" and it communicates with the interior of the intake manifold of the intake system "i" from an upper surface of the chamber through a communication passage "j". To reach chamber "h" the blow-by gas must pass from the crankcase "c" through the passage "d" in the lower walls "e" of the cylinders and into valve chambers "k" located thereabove, from which it then passes through upper walls of the cylinders to the chamber "h" and recycled into the intake manifold. Again, with this arrangement in a V-type engine, the oil splash is carried together with the blow-by gas through the valve chambers "k" prior to being conducted into the breather chamber "h" where the oil is separated from the gas. However, this results in an increase in the amount of oil in the valve chambers "k" and requires a relatively long passage until the oil returns to the oil pan "b", so the oil level in the oil pan is lowered. Further, since the device forming chamber "h" is positioned in the V between the banks of cylinders, the upper wall of the engine and that area become complicated and congested whereby the cost of manufacture is increased and water and other material may accumulate.

Viewed from one aspect the present invention provides a breather system in a V-type engine, for recycling blow-by gas from a crankcase to an intake system through a breather chamber, wherein the said breather chamber is formed integrally with an underside of a V-bank bottom wall of the engine, and passage means is provided for conducting the blow-by gas from the crankcase through said breather chamber and then into valve chambers located thereabove for recycling into said intake system.

Viewed from another aspect the invention provides a breather system in an internal combustion engine having an oil sump below a crankcase supporting a crankshaft, wherein blow-by gas take-out ports are formed in the crankcase for recycling blow-by gas from the crankcase to an intake system, said blow-by gas take-out ports being positioned outside of end bearing walls for supporting the crankshaft.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:–

Figure 1A is a sectional end view of a conventional crankcase breather arrangement in an in-line type internal combustion engine.

Figure 1B is a sectional end view of a conventional crankcase breather arrangement in a V-type engine.

Figure 2 is a sectional end view of a V-type engine employing a breather arrangement of the present invention.

Figure 3 is a sectional side elevation view of the engine taken substantially on the line III–III in Fig. 2.

Figure 4 is a sectional end view taken substantially on the line IV–IV in Fig. 3.

Figure 5 is a sectional end view taken substantially on the line V–V in Fig. 3.

Figure 6 is a bottom view of the inside of the engine of Figs. 2–5 at the base of the "V" between the cylinders and taken substantially on the line VI–VI in Fig. 2.

Figure 7 is a diagrammatic sectional end view of the engine similar to Fig. 2 for illustrating the operation of the arrangement of this invention.

Referring now in detail to the drawings, Fig. 2 shows an example of an application of a breather device and arrangement embodying the invention to a V-type engine 1, comprising a V-type cylinder block 2 and a pair of cylin-

der heads 3 mounted above the cylinder block 2. Below the cylinder block 2 is provided an oil pan to form an oil sump 4. Pistons 5 of plural cylinders in the cylinder block 2 are connected through connecting rods 6 to a crankshaft 8 mounted in a crankcase 7, and plural intake and exhaust valves 9 are mounted in each cylinder head 3. A camshaft 10 is provided for opening and closing the valves 9 similar to any OHC type engine.

The engine construction as thus far described is not particularly different from the conventional one shown in Fig. 1B, but according to the present embodiment the blow-by gas handling ports, passages and arrangement are substantially different. The blow-by gas take-out ports 11 are positioned outside bearing walls 13 for the crankshaft 8 on both outside ends of the engine in the crankshaft direction in the crankcase 7. More specifically, as shown in Figs. 3 to 5, the blow-by gas take-out ports 11 comprising lower opening ends of spaces 15 formed between outside faces of the bearing walls 13 and cover members 14 applied thereto. A breather chamber 16 is formed on the underside of the V bank bottom wall 16d of the cylinder block 2, and each space 15 communicates with the chamber 16 through a hole 16b. In V6 engine illustrated in Fig. 3, there are three small chambers 16 and each is connected to the other by a hole 16a extending through a bearing wall 13. Each small chamber 16 is cast in the cylinder block 2 to be completely open in the downward direction. A cover member 16c is mounted on the bottom of and encloses each small chamber 16. Bolts 16d mount the covers 16c to the cylinder block 2.

The breather chamber 16 communicates with a valve chamber 3a formed in the upper portion of each cylinder head 3 through a communication passage 17 formed in the cylinder wall of the block 2 (see Fig. 2). One of the valve chambers 3a communicates with an intake manifold 19a of the intake system 19 through a PCV valve 18, while the other valve chamber 3a communicates with the upstream side of a throttle valve 20 at the air cleaner 19b. Thus, the blow-by gas in the crankcase 7 is recycled from the take-out ports 11 to the intake system through the breather chamber 16 first and then through the valve chambers 3a.

In this arrangement, as shown in Fig. 7, when the amount of blow-by gas from the crankcase 7 is relatively small, fresh air is introduced from the air cleaner case 19b into the chamber 16 through the passage 19c and valve chamber 3a (on the left in Fig. 2), then through the communication passage 17 formed in the left-hand cylinder wall, then together with the blow-by gas it passes through the communication passage 17 formed in the right-hand cylinder wall, and then through the PCV valve 18 and is recycled into the intake manifold 19a. When the amount of blow-by gas is relatively large, the blow-by gas recycle is made from the chamber 16 through both communication passages 17 to the valve chambers 3a and then from the left side chamber 3a into the air cleaner case 12 and from the right side chamber 3a into the intake manifold 19a through the PCV valve 18.

In the drawings, the numeral 21 denotes a baffle plate disposed in the crankcase 7 for reducing the effects of oil splashing, and the numeral 22 denotes an oil return passage formed in the cylinder wall of the cylinder block 2 for returning the oil from each valve chamber 3a into the oil sump 4.

The operation of the present embodiment will now be explained on the basis of the above-described system. The blow-by gas in the crankcase 7 of the engine 1 is recycled from the take-out ports 11 to the intake system through the breather chamber 16 and valve chambers 3a. This point is not specially different from the prior art. However, according to conventional construction, as shown in Figs. 1A and 1B, the take-out port "d" is provided in the skirt portion "e" of the cylinder block located above the crankcase "a", thus causing the previously described problems. On the other hand, in the present embodiment, the blow-by gas take-out ports 11 are formed in positions outside the bearing walls 13 at the ends of the crankshaft 8 located on both outside ends of the crankcase 7. Each bearing wall 13 acts as a shielding plate, so the blow-by gas take-out port 11 is less influenced by pressure variations and oil splashes caused by rotation of the crankshaft 8.

Moreover, even when the oil in the crankcase 7 is biased to one end of the crankshaft at the time of cornering (for a laterally mounted engine) or acceleration and deceleration (for a longitudinally mounted engine) whereby one of the blow-by gas take-out ports 11 is blocked with the oil, the other take-out port is kept open, thereby insuring the clear passage of the blow-by gas. Moreover, in the above embodiment the take-out ports 11 are formed on both sides as a pair positioned in front and in the rear in a direction perpendicular to the crankshaft 8 with the bearing portion of the bearing wall 13 therebetween, and this arrangement is advantageous because one of each pair of take-out ports 11 is kept open not only when oil is biased in the direction of the crankshaft 8 of the engine 1 but also when it is biased in a perpendicular to the crankshaft 8, such as during combined acceleration and cornering.

Thus, according to the present embodiment, since blow-by gas take-out ports are positioned outside the bearing walls for the crankshaft which are located at both ends in the crankshaft direction of the crankcase, both such bearing walls act as shielding plates, so

pressure variations and oil spashes caused by the rotation of the crankshaft can be prevented or reduced. Besides, even when oil is biased to one side in the crankshaft direction, one of the take-out ports on both sides is kept open and insures the recycling of blow-by gas.

Another important feature of the present embodiment will be apparent from a further comparison with the prior art arrangement shown in Fig. 1B wherein the blow-by gas passes through the valve chambers "k" prior to being conducted into the breather chambers "h", so that some oil is separated from the gas in the valve chamber "k", thus increasing the amount of oil in the valve chambers "k". Further, the breather chamber "h" is positioned in an inconvenient location above the V bank bottom wall of the engine "c". On the other hand, in the present embodiment, blow-by gas is conducted from the crankcase 7 directly into the breather chamber 16, so that the oil first is separated there from the gas, that is, the amount of oil conducted into the valve chambers 3a decreases. Since the chamber 16 is relatively close to the oil sump 4, the oil in the chamber 16 returns to the oil sump 4 promptly, and since the chamber 16 is integrally formed under the V bank bottom wall 16d, the upper surface of the bottom wall 16d is flat for preventing the accumulation of water or the like.

It is to be clearly understood that there are no particular features of the foregoing specification, or of any claims appended hereto, which are at present regarded as being essential to the peformance of the present invention, and that any one or more of such features or combinations thereof may therefore be included in, added to, omitted from or deleted from any of such claims if and when amended during the prosecution of this application or in the filling or prosecution of any divisional application based thereon.

CLAIMS

1. A breather system in a V-type engine, for recycling blow-by gas from a crankcase to an intake system through a breather chamber, wherein the said breather chamber is formed integrally with an underside of a V-bank bottom wall of the engine, and passage means is provided for conducting the blow-by gas from the crankcase through said breather chamber and then into valve chambers located thereabove for recycling into said intake system.

2. A system as claimed in Claim 1, wherein said passage means include passages formed in cylinder walls of the engine extending from said breather chamber to the valve chambers.

3. A system as claimed in Claim 1 or 2, wherein said passage means includes spaces formed at each end of the engine beyond bearing walls for supporting the engine crankshaft, said spaces opening to both the breather chamber and the crankcase.

4. A system as claimed in any of Claims 1 to 3, wherein said passage means includes passages extending from each valve chamber to the intake system.

5. A system as claimed in Claim 4, wherein said passage extending from one valve chamber is connected to an air filter housing of the intake system.

6. A system as claimed in Claim 5, wherein said passage extending from the other valve chamber is connected through a PCV valve to the intake system.

7. A system as claimed in any preceding Claim, wherein said breather chamber includes downwardly open spaces, and removable covers enclosing said spaces from the bottom.

8. A breather system in an internal combustion engine having an oil sump below a crankcase supporting a crankshaft, wherein blow-by gas take-out ports are formed in the crankcase for recycling blow-by gas from the crankcase to an intake system, said blow-by gas take-out ports being positioned outside of end bearing walls for supporting the crankshaft.

9. A system as claimed in Claim 8, wherein at least one of said blow-by gas take-out ports includes portions on opposite sides of the crankshaft.

10. A system as claimed in Claim 8, wherein each said blow-by gas take-out port is comprised of a pair of passages with one passage on one side of the crankshaft and the other passage of the pair on the other side of the crankshaft.

11. A system as claimed in any of Claims 8 to 10, wherein a breather chamber is provided for separating entrained oil from the blow-by gas, and means for communicating said blow-by gas take out ports directly to said breather chamber.

12. A system as claimed in Claim 11, wherein the engine is V-type engine having a cylinder block with a bottom wall at the base of the V, and said breather chamber is integrally formed in said bottom wall.

13. A system as claimed in Claim 11 or 12, wherein passage means are provided for conducting the blow-by gas from the breather chamber to overhead valve chamber means.

14. A system as claimed in Claim 13, wherein means are provided for conducting the blow-by gas from said valve chamber means to the intake system of the engine.

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